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Predictors of length of stay in patients having elective colorectal surgery within an enhanced recovery protocol

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ABSTRACT

Background: Enhanced recovery after surgery (ERAS) pathways has been shown to minimize the duration of hospital stay. The aim of this study was to identify which factors have the greatest impact at reducing the length of stay within an enhanced recovery programme.

Methods: A retrospective case note review of patients undergoing open elective colorectal resections between August 2007 and May 2009 was performed. Data on numerous pre, peri and postoperative variables were collected. Postoperative complications, readmissions, length of stay and fitness for discharge were recorded. Using logistic regression analysis, univariate and multivariate analysis of predictors for a shorter hospital stay was performed. Odd ratios and ninety-five percent confidence intervals were calculated and a p-value of less than 0.05 was significant.

Results: There were 231 patients, of which 130 were female. Median age was 68 (IQR 56–76) years. Median length of stay was 6 (IQR 5–9) days. On multivariate analysis, ASA grade (OR 2.85 (95%CI 1.17–6.89), $p = 0.040$), the avoidance of oral opiates in the postoperative period (OR 0.39 (95%CI 0.18–0.84), $p = 0.016$) and the duration of use of epidurals for postoperative analgesia (OR 0.44 (95%CI 0.12–0.94), $p = 0.023$) were found to be significant predictors of reduced hospital stay.

Conclusion: Lower ASA grade, use of epidurals and avoidance of regular oral opiates are associated with an earlier discharge in an ERAS programme.

1. Introduction

Duration of hospital stay is frequently used as a surrogate end point indicating the success of excisional colorectal surgery. Enhanced Recovery after Surgery (ERAS) protocols are now well accepted as a means by which length of stay can be successfully and consistently reduced without increasing readmissions, complications or cost of care.[1–4] ERAS protocols comprise of a series of measures which are implemented before, during and after surgery – with the intention that their cumulative effect will accelerate recovery of organ and specially gut function and hence reduce the length of stay. The components of a typical ERAS protocol comprise of preoperative education, a brief period of preoperative fasting along with carbohydrate loading and the avoidance of mechanical bowel preparation. In the preoperative period short and preferably transverse incisions, regional analgesia along with avoidance of opiates and avoidance of abdominal drains and nasogastric tubes are advocated.[3,4]

Over the years, numerous slightly differing ERAS protocols have been formulated and there is considerable variance as to what constitutes an ERAS pathway.[5] For instance, while the protocol in our institute necessitates patients to have a short duration of fasting preoperatively, high inspired oxygen (80%) and active warming these modalities have been adopted in few other studies.[6,7] Conversely, prophylactic use of laxatives[8] and antiemetics[9,10] during the postoperative period appear to be a part of other studies but not in ours. Although all components of ERAS pathways have been proven to be advantageous to some extent on their own, it is not clear as to which of these components have a greater impact on reducing the length of stay. In addition, patient characteristics may also have a direct impact on the length of stay. The aim of our study was to identify those factors which have a significant impact on patients' length of stay in hospital after undergoing elective colorectal surgery.

2. Methods

2.1. Patients

A retrospective review of 231 consecutive patients undergoing elective open bowel resection between August 2007 and May 2009 was performed. Type and

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duration of operation and the incision used presence of stoma, use of opiates and epidurals and postoperative complications were recorded. Non-modifiable factors such as patients' demographics, American Society of Anaesthesiologists (ASA) grade and final histopathology were also recorded.

2.2. Enhanced recovery protocol

Patients were managed using the Scarborough ERAS protocol.[11] Details of this protocol are shown in Appendix 1. All patients underwent open colorectal resections. Incision length was minimized and incisions were performed in a transverse fashion whereever possible. Transverse incisions were made according to the site of the colonic pathology and the intended resection to enable a curative resection. Patients with right-sided colonic lesions had a transverse incision on the right side of the abdomen, just below or above the level of the umbilicus depending upon the level of the tumour. Similarly, patients with left sided colonic lesions had a transverse incision on the left side of the abdomen. The initial incision was extended laterally in a 'hockey-stick' manner where necessary to enable adequate mobilisation of the splenic flexure.

Patients received epidurals for postoperative analgesia when possible. If epidurals were technically impossible or failed to work despite successful insertion, patients were then prescribed intravenous morphine that was titrated via patient-controlled analgesic (PCA) devices. Epidurals and/or PCA devices were ceased as soon as possible when patients were comfortable and postoperative pain was controlled with regular oral analgesia. Oral opiates were avoided when possible. All patients received 4 g of paracetamol and 1.2 g of ibuprofen routinely.

2.3. Fitness for discharge and total length of stay

Patients with satisfactory progress in the postoperative period who had restoration of normal gut function (defined as the ability to tolerate three light meals in a day), were not requiring intravenous medication and were sufficiently mobile unaided were said to be medically 'fit for discharge'.

2.4. Morbidity and mortality

Early postoperative complications and mortality within 30 days of an operation were recorded. Patients who had a re-laparotomy during the same admission were recorded. After discharge, any readmission within 30 days was documented. All patients were routinely reviewed in the outpatients department in 6–8 weeks time.

2.5. Statistical analysis

To enable us to determine univariate and multivariate predictors for a delayed discharge, median length of stay was calculated. Patients with a length of stay above the median were classified into 'long' group while those patients with a length of stays below the median were classified into a 'short' group. All data were recorded on an Excel spreadsheet and then analysed using standard statistical software (SPSS Version 11 for Windows). For univariate analysis, comparisons of categorical data were performed with the Chi Square test; comparisons of continuous data were performed with the Mann Whitney's *U*-test.

Predictors for a shorter length of stay on univariate analysis were entered into a multivariate logistic regression model. Odds ratios and confidence intervals for each variable were obtained. A *p*-value of less than 0.05 was deemed significant.

3. Results

3.1. Patients

There were 231 patients of which 130 were female. Median age was 68 (IQR 56–76) years. Median body mass index was 25 (IQR 22–28). Fitness for surgery varied in our study population. Of the 231 patients, 46 (20%) were ASA I, 128 (55%) were ASA II and the remainder were ASA III.

3.2. Operative details

Median operative time was 100 (IQR 70–120) min. One hundred and fifty eight (68%) procedures were done for cancer. None of the procedures were done laparoscopically. The procedures in our study population are detailed in Table 1. One hundred and sixty five (71%) patients did not have a stoma at time of surgery. Of the 231 patients, 116 (50%) had a laparotomy with a transverse incision, the remainder through a midline incision.

Table 1
Operative procedures.

Procedure	Numbers
Anterior resection	48
Left hemicolectomy	47
Right hemicolectomy	74
Extended right hemicolectomy	14
Subtotal colectomy	12
Panproctocolectomy	14
Hartmann's procedure	4
Abdominoperineal excision of rectum	1
Others	17

3.3. Postoperative analgesia

Two hundred and seventeen (93%) patients had successful epidurals for postoperative analgesia. The majority (80%) of patients were able to have their epidurals withdrawn within 48 h. Ninety three (40%) patients had their epidurals withdrawn within the first 24 h of their operation and a further ninety four (40%) patients had their epidurals withdrawn between 24 and 48 h interval. Fourteen patients had failed or unsatisfactory epidurals which required the use of a patient-controlled analgesic syringe driver containing intravenous morphine. The use of regular oral opiates was noted in 67 (29%) patients.

3.4. Morbidity and mortality

The details of postoperative morbidity in our study population are detailed in Table 2. Forty-one (18%) patients had postoperative complications. Postoperative septic complications were seen in 19 (8%) patients. These included patients who developed wound infections, pneumonias and urinary tract infections. These patients were treated with intravenous antibiotics according to local antimicrobial policy. Postoperative ileus was seen in 12 (5%) patients. All patients were treated conservatively with nasogastric decompression and intravenous fluids. Five patients (2%) had anastomotic leakage confirmed on CT Scanning. All five patients required a re-laparotomy. There were eight (3%) deaths in our study population.

3.5. Length of stay

The overall median length of stay was 6 (IQR 5–9) days. Median fitness for discharge was shorter by a day (5 (IQR 4–7) vs. 6 (IQR 5–9) days, $p = 0.03$). Readmissions were seen in 6 (3%) patients.

3.6. Predictors of length of stay

As mentioned, all patients were divided into one of two groups (short vs. long) based upon their overall length of stay. Median length of stay for the short group was 5 (IQR 4–6) days. Median length of stay for the long group was 9 (IQR 8–13) days. On univariate analysis 10 variables were found to be significant predictors of a shorter in

Table 2
Postoperative morbidity.

Complication	Numbers
Wound infection	8
Pneumonia	6
Urinary tract infection	5
Prolonged ileus	12
Anastomotic leakage	5
Myocardial infarction	3
Transient ischaemic attack	2

hospital stay (Table 3). However on multivariate analysis, only 3 variables were found to be significant. The 3 significant variables were: the patients' fitness for surgery (ASA grade), the avoidance of oral opiates in the postoperative period and, the duration of use of epidurals for postoperative analgesia (Table 4).

4. Discussion

The purpose of this study was to determine those factors which have maximum impact on accelerating recovery after surgery by reducing the length of stay. Our outcomes in terms of length of stay, morbidity and mortality were comparable with previously published series.[12–14] Although on univariate analysis 10 factors were associated with a reduction of length of stay, on multivariate analysis only ASA grade, avoidance of regular oral opiates in the postoperative period and the duration of use of epidurals were predictors of earlier discharge from hospital.

The use of epidurals is associated with variations in the overall length of stay. Admittedly, a large proportion (93%) of our patients received epidurals for postoperative analgesia. Because of this, it is difficult to demonstrate cause and effect between the use of epidural and its impact on length of stay. However, patients with a brief use of epidurals were twice as likely to have a shorter length of stay when compared with those who had prolonged use of epidurals (OR 0.44 (95%CI 0.12–0.94), p-value = 0.023). A recent

Table 4
Multivariate analysis of predictors for a prolonged length of stay.

Variable	Odds ratio (95% CI)	P-value
Choice of incision	2.03 (0.93–4.43)	0.076
Histopathology	0.39 (0.03–5.63)	0.905
Type of operation	1.09 (0.19–6.33)	0.331
Fitness for surgery	2.85 (1.17–6.89)	0.040
Use of stoma	0.90 (0.33–2.47)	0.844
Use of oral opiates	0.39 (0.18–0.84)	0.016
Use of epidurals	0.44 (0.12–0.94)	0.023
Complications	0.41 (0.07–2.31)	0.064
Death	0.28 (0.01–6.21)	0.419
Age	0.98 (0.96–1.01)	0.278

Table 3
Univariate analysis of predictors for length of stay.

Variables		Length of stay		P-value
		Short (n = 120)	Long (n = 111)	
Choice of incision	Transverse	71	45	0.005
	Midline	49	66	
Gender	Female	68	62	0.901
	Male	52	49	
Histopathology	Cancer	80	78	0.044
	Others	40	33	
Grade of malignancy (including Dukes)	Dysplasia/Carcinoma in situ	9	5	0.257
	A	8	11	
	B	36	27	
	C	25	34	
	D	2	1	
	Others	49	38	
Type of operation	Anterior Resection	29	19	0.029
	Left hemicolectomy	28	19	
	Right hemicolectomy	36	38	
	Extended right hemicolectomy	6	8	
	Subtotal colectomy	3	9	
	Panproctocolectomy	3	11	
	Hartmann's procedure	2	2	
	Abdominoperineal excision of rectum	0	1	
	Others	13	4	
Fitness for surgery (ASA)	I	33	13	0.001
	II	70	58	
	III	17	40	
Use of stoma	Yes	27	39	0.034
	No	93	72	
Use of oral opiates	Yes	23	44	0.001
	No	97	67	
Use of epidurals	None	6	8	0.020
	<24	60	33	
	24–48	41	53	
	>48	13	17	
Complications	Yes	6	35	0.001
	No	114	76	
Readmission	Yes	3	2	0.716
	No	117	109	
Mortality	Yes	1	7	0.023
	No	119	104	
Age		64 (IQR 52–72)	71 (IQR 61–78)	0.001
Body mass index		25 (IQR 22–28)	25 (IQR 22–28)	0.576
Operative duration		100 (IQR 76–120)	95 (IQR 70–130)	0.818

metaanalysis showed that although epidural analgesia improves postoperative pain control, it does not lead to a reduction in length of stay.[15] However not all studies included in this metaanalysis used the principles of ERAS. A number of studies have also questioned the usefulness of epidural analgesia after laparoscopic colorectal resection.[16,17]

In our study, use of regular doses of opiate based analgesics was associated with a delay in discharge. ERAS protocols are thought to work by accelerating the recovery of gut function.[11,18] This view is supported by our results. Both avoidance of opiates and the use of epidurals have a beneficial effect on the early recovery of gut function by reducing the sympathetic tone and the stress response to surgery.[19] Although we did not directly measure the return of gut function, it is plausible that the earlier discharge of these patients was a consequence of earlier return of their gut function. Since a multivariate analysis does not demonstrate a causal effect, further research into the causes of postoperative ileus is required.

In our study, age was not found to be a predictor of length of stay on multivariate analysis whereas ASA grade was. These findings are partly supported by the results of a larger and recently published multivariate analysis which found that both advanced age and ASA grade were predictors of length of stay.[20] Our findings may reflect the fact that the elderly comprise a variable group and may have different levels of co-morbidities and cancer stage.[21,22] In addition, stage for stage, elderly patients who have significant co-morbidities are not always offered resectional surgery and therefore an element of selection bias is inevitable in our cohort of patients.

The results of our multivariate analysis also suggest that the use of transverse incisions has a limited role in enhanced recovery packages. There is evidence to suggest that transverse incisions reduce analgesic requirements, pulmonary complications, and systemic inflammatory responses.[23–25] We made a conscious attempt to minimize the size of the incision. With this in mind, patients with transverse incisions do not appear to have a shorter length of stay (OR 2.03 (95%CI 0.93–4.43), p-value = 0.076). Our findings are supported by those of a recent randomised controlled study.[26] In this study, two hundred patients were randomised into midline versus transverse incisions. Using visual analogue scores, there was no difference in pain scores between the two arms of the study. Likewise postoperative morbidity and mortality was similar in both arms of the study.

Our overall length of stay was significantly longer by a day when compared with fitness for discharge (6 (IQR 5–9) days vs. 5 (IQR 4–7) days, p-value = 0.03). It remains debatable as to whether fitness for discharge is a better primary endpoint when compared with overall length of stay. Time to fitness for discharge is less influenced by non-medical factors which delay discharge after surgery. Whilst fitness for discharge should, in theory, be a more appropriate endpoint when compared with LOS dates (as it is less influenced by social factors) we chose to study the factors which influence the LOS, as it is a more recognisable endpoint in the published literature. In addition, fitness to discharge can often be a subjective assessment and its defining criteria often vary between centres. Unanticipated delays of discharge from hospital frequently occur because of reductions in the mobility of patients and increasing needs for institution of home care packages.[27] Additionally, in those patients who require the formation of a stoma, postoperative training and education by specialist nurses often requires input over several sessions.[28] While preoperative assessment can often anticipate potential problems associated with patient discharge in terms of mobility or need for home packages, stomal education has often been left as a postoperative afterthought. However, on multivariate analysis, the presence of a stoma did not lead to a delay in discharge in our study. This may be because, as a part of our ERAS protocol, we offered comprehensive preoperative stoma training to appropriate patients.

All components of ERAS work synergistically.[1–4] Whilst the results of the present study suggest that the use of epidurals and the avoidance of opiates are the most important factors in an ERAS package, this does not permit the conclusion that other factors have no benefit. This was emphasised in one of our previous studies in which epidurals were used in both a control group and an ERAS study group. Despite effectively excluding the effect of epidurals from subsequent data analysis we still found significant benefits to the patients who were part of an ERAS package.[17] The importance of the use of all components of ERAS as a package is also evident from previous studies on individual components of ERAS. These studies have shown that only modest benefits are obtained when the individual components of ERAS are used.[14,29,30] The evidence suggests therefore that it is the cumulative benefit from all components of an ERAS package that is important.

Our study has some limitations. Firstly, data were collected retrospectively. For this reason both medical and nursing notes along with physiotherapy charts were simultaneously reviewed. Despite this, the influence of certain other elements such as preoperative counselling and carbohydrate loading and early postoperative diet could not be studied. Further, factors such as perioperative warming and restricted intravenous fluids were not assessed because these are now an integral part of our daily clinical practice and used in all patients. Secondly, patients who underwent laparoscopic resection were not included.

In summary, we have shown that within an enhanced recovery package that the use of epidurals and the avoidance of opiates have the greatest impact on the length of hospital stay. Efforts should be taken to ensure high compliance to these modalities. Lastly, length of stay is also influenced by patients' ASA grade and this should be considered in discharge planning.

Appendix 1. Enhanced recovery after surgery (ERAS) protocol at Scarborough[11]

Phase	Intervention
Preoperative	Preassessment and education by senior surgeon and anaesthetist No bowel preparation Oral carbohydrate loading Minimal fasting (2–3 h)
Intraoperative	High inspired oxygen (80%) Minimally sized incisions Avoidance of drains and nasogastric tubes
Postoperative	Early fluid and diet reintroduction Structured mobilisation plan Avoidance opiate analgesics

Conflict of interest
None to declare.

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Ethical approval
This audit was approved by the Department of Clinical Audit.

References

1. Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast track surgery. *Ann Surg* 2008;**248**:189–98.
2. Wind J, Polle SW, Fung Kon Jin PH, Dejong CH, von Meyenfeldt MF, Ubbink DT, et al. Systematic review of enhanced recovery programmes in colonic surgery. *Br J Surg* 2006;**93**:800–9.
3. Kehlet H. Fast-track colorectal surgery. *Lancet* 2008;**371**:791–3.
4. Lassen K, Soop M, Nygren J, Cox PB, Hendry PO, Spies C, et al. Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery After Surgery (ERAS) Group recommendations. *Arch Surg* 2009;**144**:961–9.

5. Walter CJ, Collin J, Dumville JC, Drew PJ, Monson JR. Enhanced recovery in colorectal resections: a systematic review and meta-analysis. *Colorectal Dis* 2009;**11**:344–53.
6. Schwenk W, Günther N, Wendling P, Schmid M, Probst W, Kipfmüller K, et al. Fast-track Colon II Quality Assurance Group. Fast-track rehabilitation for elective colonic surgery in Germany-prospective observational data from a multi-centre quality assurance programme. *Int J Colorectal Dis* 2008;**23**:93–9.
7. Kahokehr A, Sammour T, Zargar-Shoshtari K, Thompson LG, Hill GA. Implementation of ERAS and how to overcome the barriers. *Int J Surg* 2009;**7**:16–9.
8. Polle SW, Wind J, Fuhring JW, Hofland J, Gouma DJ, Bemelman WA. Implementation of a fast-track perioperative care program: what are the difficulties? *Dig Surg* 2007;**24**:441–9.
9. Maessen J, Dejong CHC, Hausel J, Nygren J, Lassen K, Andersen J, et al. A protocol is not enough to implement an enhanced recovery programme for colorectal resection. *Br J Surg* 2007;**94**:224–31.
10. Nygren J, Hausel J, Kehlet H, Revhaug A, Lassen K, Dejong C, et al. A comparison in five European Centres of case mix, clinical management and outcomes following either conventional or fast track perioperative care in colorectal surgery. *Clin Nurt* 2005;**24**:455–61.
11. Gatt M, Anderson AD, Reddy BS, Hayward-Sampson P, Tring IC, MacFie J. Randomized clinical trial of multimodal optimization of surgical care in patients undergoing major colonic resection. *Br J Surg* 2005;**92**:1354–62.
12. Teeuwen PH, Bleichrodt RP, Strik C, Groenewoud JJ, Brinkert W, van Laarhoven CJ, et al. Enhanced recovery after surgery (ERAS) versus conventional postoperative care in colorectal surgery. *J Gastrointest Surg* 2010;**14**:88–95.
13. Nygren J, Soop M, Thorell A, Hausel J, Ljungqvist O. ERAS Group. An enhanced recovery protocol improves outcome after colorectal resection already during the first year: a single-center experience in 168 consecutive patients. *Dis Colon Rectum* 2009;**52**:978–85.
14. Khoo CK, Vickery CJ, Forsyth N, Vinall NS, Eyre-Brook IA. A prospective randomized controlled trial of multimodal perioperative management protocol in patients undergoing elective colorectal resection for cancer. *Ann Surg* 2007;**245**:867–72.
15. Marret E, Remy C, Bonnet F. Postoperative Pain Forum Group. Metaanalysis of epidural analgesia versus parenteral opioid analgesia after colorectal surgery. *Br J Surg* 2007;**94**:665–73.
16. Zafar N, Davies R, Greenslade GL, Dixon AR. The evolution of analgesia in an accelerated recovery programme for resectional laparoscopic colorectal surgery with anastomosis. Colorectal Dis; in press.doi:10.1111/j.14631318.2009.01768.x.
17. Levy BF, Tilney HS, Dowson HM, Rockall TA. A systematic review of postoperative analgesia following laparoscopic colorectal surgery. *Colorectal Dis* 2010;**12**:5–15.
18. Varadhan KK, Neal KR, Dejong CH, Fearon KC, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. *Clin Nutr*; 2010; doi:10.1016/j.clnu.2010.01.004.
19. Person B, Wexner SD. The management of postoperative ileus. *Curr Probl Surg* 2006;**43**:6–65.
20. Hendry PO, Hausel J, Nygren J, Lassen K, Dejong CH, Ljungqvist O, et al. Enhanced Recovery After Surgery Study Group. Determinants of outcome after colorectal resection within an enhanced recovery programme. *Br J Surg* 2009;**96**. 197–5.
21. Nascimbeni R, Di Fabio F, Di Betta E, Salerni B. The changing impact of age on colorectal cancer surgery. A trend analysis. *Colorectal Dis* 2009;**11**:13–8.
22. Heriot AG, Tekkis PP, Smith JJ, Cohen CR, Montgomery A, Audisio RA, et al. Prediction of postoperative mortality in elderly patients with colorectal cancer. *Dis Colon Rectum* 2006;**49**:816–24.
23. Grantcharov TP, Rosenberg J. Vertical compared with transverse incisions in abdominal surgery. *Eur J Surg* 2001;**167**:260–7.
24. Lindgren PG, Nordgren SR, Oresland T, Hulten L. Midline or transverse abdominal incision for right-sided colon cancer – a randomized trial. *Colorectal Dis* 2001;**3**:46–50.
25. Nakagoe T, Tsuji T, Sawai T, Sugawara K, Inokuchi N, Kamihira S, et al. Minilaparotomy may be independently associated with reduction in inflammatory responses after resection for colorectal cancer. *Eur Surg Res* 2003;**35**: 477–85.
26. Seiler CM, Deckert A, Diener MK, Knaebel HP, Weigand MA, Victor N, et al. Midline versus transverse incision in major abdominal surgery: a randomized, double-blind equivalence trial. (POVATI). *Ann Surg* 2009;**249**:913–20.
27. Bryan K, Gageb H, Gilbert K. Delayed transfers of older people from hospital: causes and policy implications. *Health Policy* 2006;**76**. 194–1.
28. Reddy KM, Meyer CE, Palazzo FF, Conaghan P, Blunt MC, Stebbings WS, et al. Postoperative stay following colorectal surgery: a study of factors associated with prolonged hospital stay. *Ann R Coll Surg Engl* 2003;**85**:111–4.
29. Nelson R, Tse B, Edwards S. Systematic review of prophylactic nasogastric decompression after abdominal operations. *Br J Surg* 2005;**92**:673–80.
30. Karliczek A, Jesus EC, Matos D, Castro AA, Atallah AN, Wiggers T. Drainage or non-drainage in elective colorectal anastomosis: a systematic review and meta-analysis. *Colorectal Dis* 2006;**8**:259–65.